REMARKS

Reconsideration and allowance of the above application as amended are respectfully requested.

Claims 1-14, 32 and 33 are pending, with Claims 1, 9, 13, and 32 being independent. Claims 1, 4, 6, 9, 11, 13, 14, 32, and 33 are currently amended.

Rejection under 35 U.S.C. §102

Claims 1, 2 and 7 stand rejected under 35 U.S.C. §102(b) as allegedly being anticipated by Sambucetti et al. (U.S. 6,335,104). This contention is respectfully traversed.

Claims 1, 3 and 8 stand rejected under 35 U.S.C. 102(e) as allegedly being anticipated by Tong et al. (US 6,827,252). This contention is respectfully traversed.

Rejection under 35 U.S.C. §103

Claims 4 and 5 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Tong in view of Mikagi et al (US Pat. Pub. 2003/0025202). This contention is respectfully traversed.

Claim 6 stands rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Sambucetti in view of Tong. This contention is respectfully traversed.

Claims 9 and 13 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Tong in view of Jin et al (US 6,740,577). This contention is respectfully traversed.

Claims 10 and 14 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Tong and Jin as applied to claim 9, and further in view of Sambucetti. This contention is respectfully traversed.

Claims 11 and 12 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Tong and Jin as applied to claim 9, and further in view of Mikagi. This contention is respectfully traversed.

Claims 32 and 33 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Tong in view of Kazama et al (US 6,639,315). This contention is respectfully traversed.

35 U.S.C. 102 - Claim 1

The amended Claim 1 is patentable over Sambucetti and Tong at least because these references fail to anticipate each and every feature of the claim as arranged in the claim. For example neither Sambucetti nor Tong discloses the amended feature of "a diffusion barrier in contact with the first conducting layer, wherein the diffusion barrier comprises a metal alloy comprising boron and phosphorus" (emphasis added).

The amendments to Claim 1 do not add new matter and are supported within the specification (e.g., instant disclosure: page 6, lines 3-4; page 7, lines 13-14; page 8, lines 12-15; page 9, lines 14-16).

Sambucetti shows a method for preparing a conductive pad for electrical connection (Sambucetti: Abstract). Sambucetti discloses a structure, as shown in Fig. 2, where the first diffusion barrier 16 includes a metal alloy material such as phosphorus or boron (Sambucetti: Col. 5, lines 61-67; Col. 6, lines 1-2). In particular, Sambucetti discloses that the diffusion barrier includes a "phosphorus or boron-containing metal alloy" (emphasis added). Thus, Sambucetti does not disclose that the diffusion barrier includes both a phosphorus and a boron-containing metal alloy. Moreover, Sambucetti discloses that "the phosphorus or boron-containing metal alloy may be selected from the group consisting of Ni-P, Co-P, Co-W-P, Co-Sn-P, Ni-W-P, Co-B, Ni-B, Co-Sn-B, Co-W-B and Ni-W-B" (Sambucetti: Abstract, Col. 3, lines 34-37; Col. 4, lines 11-13, 46-49). None of the listed alloys of Sambucetti discloses that the diffusion barrier includes both a phosphorus and a boron-containing metal alloy. For at least these reasons, Sambucetti fails to anticipate Claim 1 at least because Sambucetti fails to disclose each element of the claim.

Furthermore, the office action alleges (page 3) that Sambucetti discloses preventing CuSn intermetallic formation in Col. 1, lines 39-41. However, Sambucetti fails to disclose anything about CuSn intermetallic formation in Col. 1, lines 39-41. Instead, Sambucetti discloses "the common usage of a diffusion barrier formed of TiN for preventing aluminum diffusion into underlying conductive layers" (emphasis added). Therefore, this assertion in the office action is incorrect and cannot be used to reject Claim 1 under 35 U.S.C. 102.

Tong teaches a method of forming bumps on the active surface of a silicon wafer, in which an under-ball metallic layer serves as a barrier blocking the diffusion of metallic particles into the insulation layer inside the wafer (Tong: Abstract; Col. 6, lines 43-46). However, Tong fails to disclose the amended feature in Claim 1 of "a diffusion barrier in contact with the first conducting layer, wherein the diffusion barrier comprises a metal alloy comprising boron and phosphorus." Instead, Tong discloses that "the barrier layer 330 is made from a material such as nickel-vanadium alloy, chromium-copper alloy or nickel" (Col. 4, lines 2-4). In another embodiment, Tong discloses that the under-ball metallic layer in Fig. 6 can have two, three, or four layers (Col. 6, lines 5-15). However, Tong fails to disclose that any of those

layers include a diffusion barrier with "a metal alloy comprising boron and phosphorus," as recited in Claim 1. For at least this reason, Tong fails to anticipate Claim 1.

At least because Tong fails to anticipate each and every feature of the claim, the Applicants submit that Claim 1 is patentable over Tong, and the rejection under 35 U.S.C. 102 should be respectfully withdrawn.

Claims 2-3, 7-8

Claims 2-3, 7-8 are patentable at least because these claims rely upon a patentable base claim, Claim 1.

Claim 2 is further patentable for reciting allowable subject matter in its own right. For example, the office action alleges (page 3) that Sambucetti discloses preventing whisker-type formations by disclosing a lift-off defect in Col. 1, lines 39-50. However, Sambucetti discloses nothing about CuSn intermetallic formation here - there is no discussion of Cu or Sn or their intermetallic formation. The type of lift-off defect in Col. 1, lines 39-50 refers to a defect between a diffusion barrier alloy and an insulator (SiO_2 - i.e., a non-metal). Also, it is known to those skilled in the art that whisker-type formations and lift-off defects are not the same phenomenon (e.g., see description related to Figs. 1A-1D of the

instant disclosure). Therefore, this assertion in the office action is incorrect and cannot be used to reject Claim 1 under 35 U.S.C. 102.

The amended Claim 7 is further patentable for reciting allowable subject matter in its own right. For example, Sambucetti fails to disclose that "the wetting layer comprises CoB," as recited in Claim 7. Hence, the rejection under 35 U.S.C. 102 is improper and should be withdrawn.

Claims 4, 5 - 35 U.S.C. 103

Claims 4-5 are patentable at least because these claims rely upon a patentable base claim, Claim 1. Neither Tong nor Mikagi, alone or in combination, teaches or suggests all of the features as arranged in the claims.

Mikagi fails to remedy the deficiencies of Tong as described above with repect to the 35 U.S.C. 102 rejection to Claim 1. Mikagi teaches a semiconductor device having an external electrode (Mikagi: Abstract). However, Mikagi fails to teach or suggest "wherein the diffusion barrier comprises a metal alloy comprising boron and phosphorus." Instead, Mikagi teaches that the barrier layer is Ni or a Ni alloy, such as Ni-V (Mikagi: paragraphs 18, 49). Therefore, Claims 4-5 are patentable for this reason alone.

Claim 4 is also patentable for reciting allowable subject matter in its own right. For example, Claim 4 recites that "the seed layer comprises Co," and the suggested combination of references do not teach or suggest this feature. As acknowledged in the office action (page 5), Tong fails to show a seed layer. Mikagi teaches that the seed layer comprises Cu or Au (Mikagi: Fig. 14, paragraphs 79-80). Therefore, Claim 4 is patentable over the suggested combination of Tong and Mikagi for at least this additional reason.

Claim 6 ~ 35 U.S.C. 103

Claim 6 is patentable at least because this claim rely upon a patentable base claim, Claim 1. Neither Tong nor Sambucetti, alone or in combination, teaches or suggests all of the features as arranged in the claims. As described above, neither Tong nor Sambucetti discloses the Claim 1 feature that "the diffusion barrier comprises a metal alloy comprising boron and phosphorus." Thus, Claim 6 is patentable over the suggested combination of the references.

Claim 6 is further patentable for reciting allowable subject matter in its own right. For example, Sambucetti does not disclose that the diffusion barrier comprises NiWBP as recited in Claim 6. For reasons described above, Tong also does

not disclose that the diffusion barrier comprises NiWBP. Therefore, Claim 6 should not be rejected under 35 U.S.C. 103 to the suggested combination of Tong and Sambucetti.

Moreover, Fig. 7 of Tong does not show a bump layer as alleged in the office action. Instead, Fig. 7 shows a photoresist block 350, which is removed in the fabrication of the device (Tong: Col. 4, lines 24-25). Also, the solder blocks that are described in Tong do not teach or suggest "wherein the bump layer further comprises a Sn alloy, the Sn alloy comprising one of 0.7Cu, Bi, and Sb," as recited in Claim 6. Instead, Tong lists a menu of alloys in Col. 4, lines 54-59 that do not include those specifically recited in Claim 6. As acknowledged in the office action (page 6), Sambucetti also fails to teach or suggest the recited materials of Claim 6. For at least these reasons, the rejection to Claim 6 should be withdrawn.

Claims 9, 13 - 35 U.S.C. 103

Claims 9, 13 are patentable at least for the same reasons as described above with respect to Claim 1. Neither Tong nor Jin, alone or in combination, teaches or suggests all of the features as arranged in the claims.

Jin fails to remedy the deficiencies of Tong. For example, Jin teaches a method of forming a small pitch torch bump for

mounting high-performance flip-flop devices (Jin: Abstract). Jin shows three layers (Au layer 32, Ni layer 30, and Cu layer 28) in Figure 5 that serve as the base for the bump layer (Jin: Col. 5, lines 14-17). However, these layers do not teach or suggest "the diffusion barrier comprises a metal alloy comprising boron and phosphorus," as recited in Claim 9. Not only are the materials different from those claimed, but it would be known to those skilled in the art that those layers could not serve as a diffusion barrier. For example, it is known to those skilled in the art that Ni is not a barrier for Cu (see also, e.g., instant disclosure: Col. 5, lines 1-3). Therefore, neither Tong nor Jin, alone or in combination, teaches or suggests all of the features as arranged in the claims, and those rejections should be withdrawn.

Claims 10, 14 - 35 U.S.C. 103

Claims 10 and 14 are patentable at least for the same reasons as described above with respect to Claim 1 and base Claims 9 and 13. Neither Tong, Jin, nor Sambucetti, alone or in combination, teaches or suggests all of the features as arranged in the claims. As described above, neither Tong, Jin, nor Sambucetti discloses the Claim 1 feature that "the diffusion barrier comprises a metal alloy comprising boron and

phosphorus." Allowance of these claims is respectfully requested.

Claim 10 is further patentable for reciting allowable subject matter in its own right. For example, Claim 10 is patentable for at least the same reasons described above as Claim 2 with respect to Sambucetti. As acknowledged in the office action (pages 7-8), Jin and Tong fail to disclose the recited features of the claim. Therefore, the rejection to Claim 10 should be withdrawn.

Claim 14 is also patentable for reciting allowable subject matter in its own right. For example, Claim 14 is patentable for at least the same reasons described above as Claims 6 and 7 with respect to Sambucetti. As acknowledged in the office action (pages 7-8), Jin and Tong fail to disclose the recited features of the claim. Hence, the rejection to Claim 14 should be withdrawn.

Claims 11-12 - 35 U.S.C. 103

Claims 11-12 are patentable at least for the same reasons as described above with respect to Claim 1 and base Claim 9. Neither Tong, Jin, nor Mikagi, alone or in combination, teaches or suggests all of the features as arranged in the claims. As described above, neither Tong, Jin, nor Mikagi discloses the

Claim 1 feature that "the diffusion barrier comprises a metal alloy comprising boron and phosphorus." The Applicants respectfully request that these rejection under 35 U.S.C. 103 be withdrawn, and that Claims 11-12 be allowed.

Claim 11 is further patentable for reciting allowable subject matter in its own right. For example, Claim 11 is patentable for at least the same reasons described above as Claim 4 with respect to Mikagi. As acknowledged in the office action (page 8), Jin and Tong fail to disclose the recited features of the claim. Therefore, the rejection to Claim 11 should be withdrawn.

Claims 32-33 - 35 U.S.C. 103

Claims 32-33 are patentable at least for the same reasons as described above with respect to Claim 1. Neither Tong nor Kazama, alone or in combination, teaches or suggests all of the features as arranged in the claims. As described above, neither Tong nor Kazama discloses the Claim 1 feature that "the diffusion barrier comprises a metal alloy comprising boron and phosphorus." Therefore, these claims are patentable over the combination of the references for this reason alone.

Kazama, in showing a circuit board (10) with a circuit for routing a signal, fails to remedy the deficiencies of Tong

(Kazama: Abstract; Fig. 5). The Applicants respectfully request that the rejection under 35 U.S.C. 103 to Claim 32 be withdrawn, and that Claim 32 be allowed.

Claim 33 is patentable for depending on an allowable base claim, Claim 32. Claim 33 is further patentable for reciting allowable subject matter in its own right. For example, Claim 33 is patentable for at least the same reasons as Claim 6. Allowance of Claim 33 is respectfully requested.

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Conclusion

In view of the amendments and remarks herein, the Applicants believe that Claims 1-14, 32-33 are in condition for allowance and ask that these pending claims be allowed. The foregoing comments made with respect to the positions taken by the Examiner are not to be construed as acquiescence with other positions of the Examiner that have not been explicitly contested. Accordingly, Applicants' arguments for patentability of a claim should not be construed as implying that there are not other valid reasons for patentability of that claim or other claims.

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Respectfully submitted,

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